```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import re
import os
import sklearn
import tqdm
from tqdm import tqdm
import nltk
import warnings
warnings.filterwarnings("ignore")
import cv2
from sklearn.model_selection import train_test_split
import PIL
from PIL import Image
import time

import tensorflow as tf
import keras
from keras.layers import Input,Dense,Conv2D,concatenate,Dropout,LSTM
from keras import Model
from tensorflow.keras import activations
import warnings
warnings.filterwarnings("ignore")
import nltk.translate.bleu_score as bleu
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mou
```

```
os.chdir("/content/drive/My Drive/cs2")
```

```
'''
First we need to load the chexnet nodel (DenseNet121),
The trained weight of this model is from https://github.com/brucechou1983/CheXNet-Keras

'''
#https://github.com/antoniosehk/tCheXNet/blob/master/chexnet.py
from tensorflow.keras.applications import DenseNet121

image_shape= (224,224,3)
image_input= Input(shape=(224,224,3))
base=DenseNet121(include_top=False,input_tensor=image_input,input_shape=image_shape,pooling='
pred=Dense(14,"sigmoid")(base.output)
```

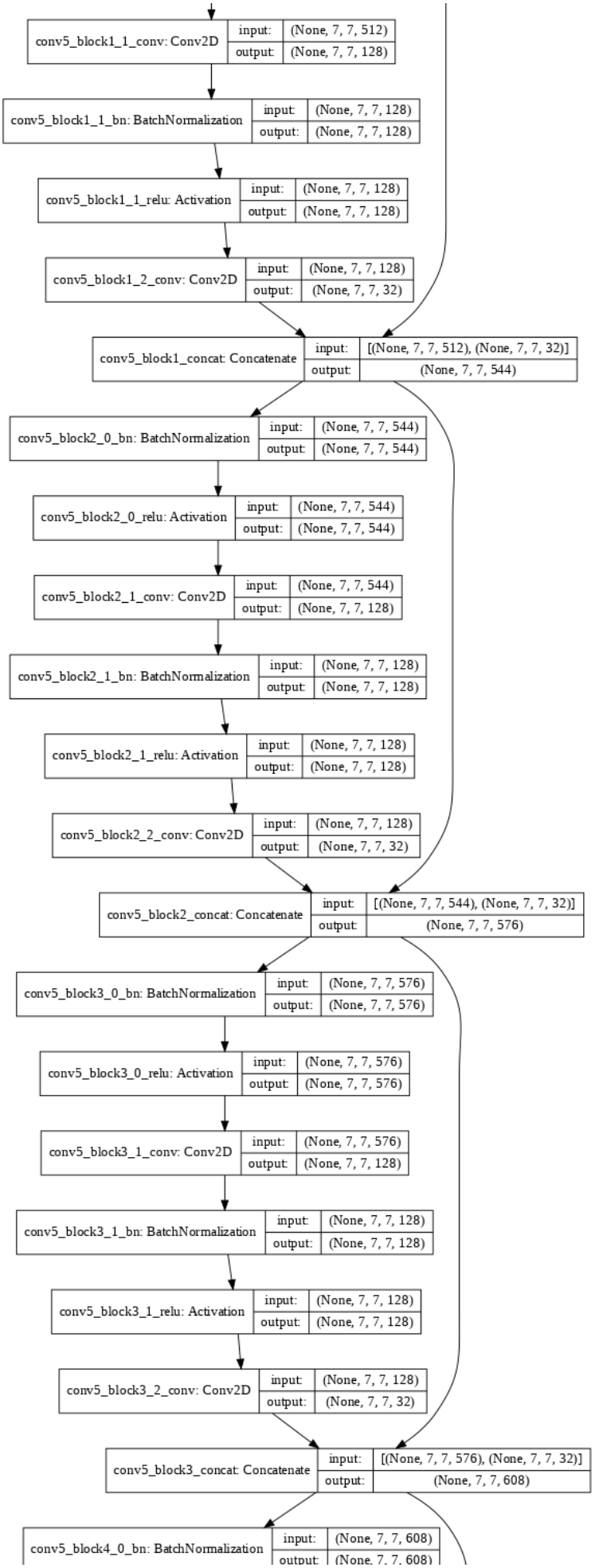
```
chexnet_model=Model(inputs=base.input,outputs=pred)
chexnet_model.load_weights("chexnet_weights.h5")

chexnet_model.summary()
```

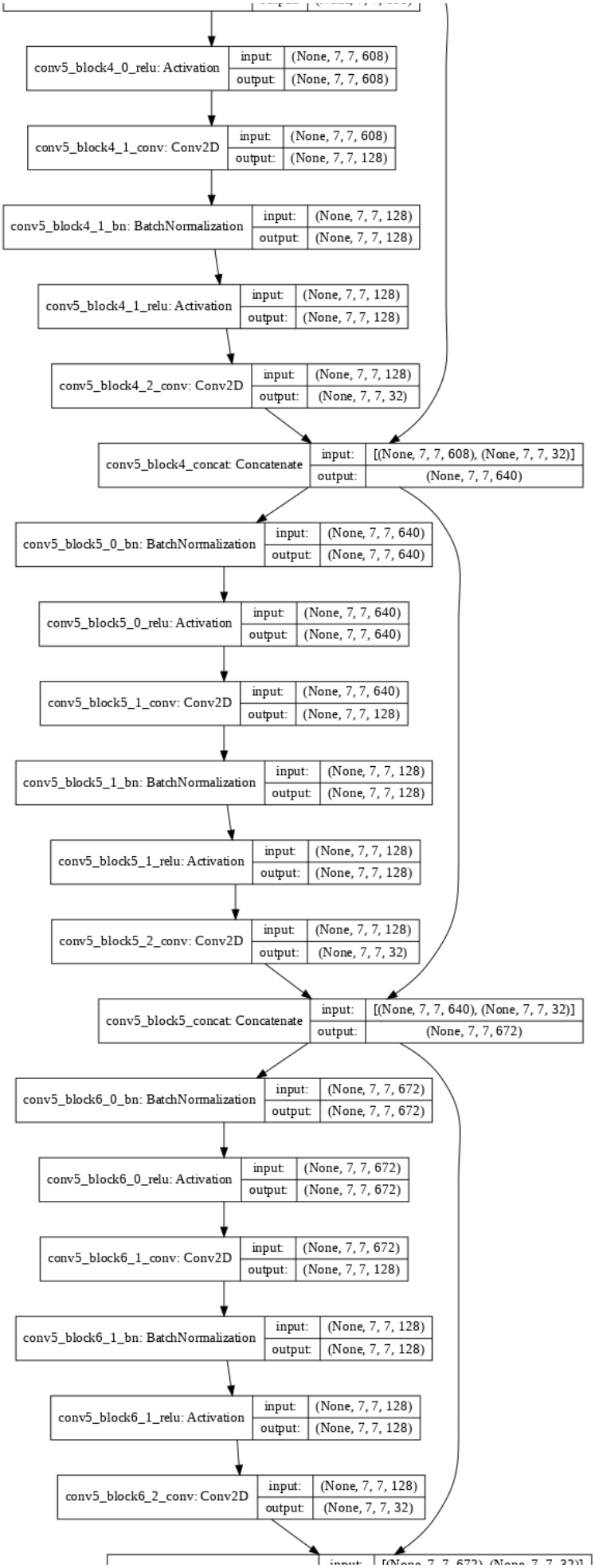
```
conv5_block14_0_bn (BatchNormal (None, 7, 7, 928)    3712        conv5_block13_conca
__________________________________________________________________________________
conv5_block14_0_relu (Activatio (None, 7, 7, 928)    0           conv5_block14_0_bn[
__________________________________________________________________________________
conv5_block14_1_conv (Conv2D)   (None, 7, 7, 128)    118784      conv5_block14_0_rel
__________________________________________________________________________________
conv5_block14_1_bn (BatchNormal (None, 7, 7, 128)    512         conv5_block14_1_con
__________________________________________________________________________________
conv5_block14_1_relu (Activatio (None, 7, 7, 128)    0           conv5_block14_1_bn[
__________________________________________________________________________________
conv5_block14_2_conv (Conv2D)   (None, 7, 7, 32)     36864       conv5_block14_1_rel
__________________________________________________________________________________
conv5_block14_concat (Concatena (None, 7, 7, 960)    0           conv5_block13_conca
                                                                 conv5_block14_2_con
__________________________________________________________________________________
conv5_block15_0_bn (BatchNormal (None, 7, 7, 960)    3840        conv5_block14_conca
__________________________________________________________________________________
conv5_block15_0_relu (Activatio (None, 7, 7, 960)    0           conv5_block15_0_bn[
__________________________________________________________________________________
conv5_block15_1_conv (Conv2D)   (None, 7, 7, 128)    122880      conv5_block15_0_rel
__________________________________________________________________________________
conv5_block15_1_bn (BatchNormal (None, 7, 7, 128)    512         conv5_block15_1_con
__________________________________________________________________________________
conv5_block15_1_relu (Activatio (None, 7, 7, 128)    0           conv5_block15_1_bn[
__________________________________________________________________________________
conv5_block15_2_conv (Conv2D)   (None, 7, 7, 32)     36864       conv5_block15_1_rel
__________________________________________________________________________________
conv5_block15_concat (Concatena (None, 7, 7, 992)    0           conv5_block14_conca
                                                                 conv5_block15_2_con
__________________________________________________________________________________
conv5_block16_0_bn (BatchNormal (None, 7, 7, 992)    3968        conv5_block15_conca
__________________________________________________________________________________
conv5_block16_0_relu (Activatio (None, 7, 7, 992)    0           conv5_block16_0_bn[
__________________________________________________________________________________
conv5_block16_1_conv (Conv2D)   (None, 7, 7, 128)    126976      conv5_block16_0_rel
__________________________________________________________________________________
conv5_block16_1_bn (BatchNormal (None, 7, 7, 128)    512         conv5_block16_1_con
__________________________________________________________________________________
conv5_block16_1_relu (Activatio (None, 7, 7, 128)    0           conv5_block16_1_bn[
__________________________________________________________________________________
conv5_block16_2_conv (Conv2D)   (None, 7, 7, 32)     36864       conv5_block16_1_rel
__________________________________________________________________________________
conv5_block16_concat (Concatena (None, 7, 7, 1024)   0           conv5_block15_conca
                                                                 conv5_block16_2_con
__________________________________________________________________________________
bn (BatchNormalization)         (None, 7, 7, 1024)   4096        conv5_block16_conca
__________________________________________________________________________________
relu (Activation)               (None, 7, 7, 1024)   0           bn[0][0]
__________________________________________________________________________________
avg_pool (GlobalAveragePooling2 (None, 1024)         0           relu[0][0]
```

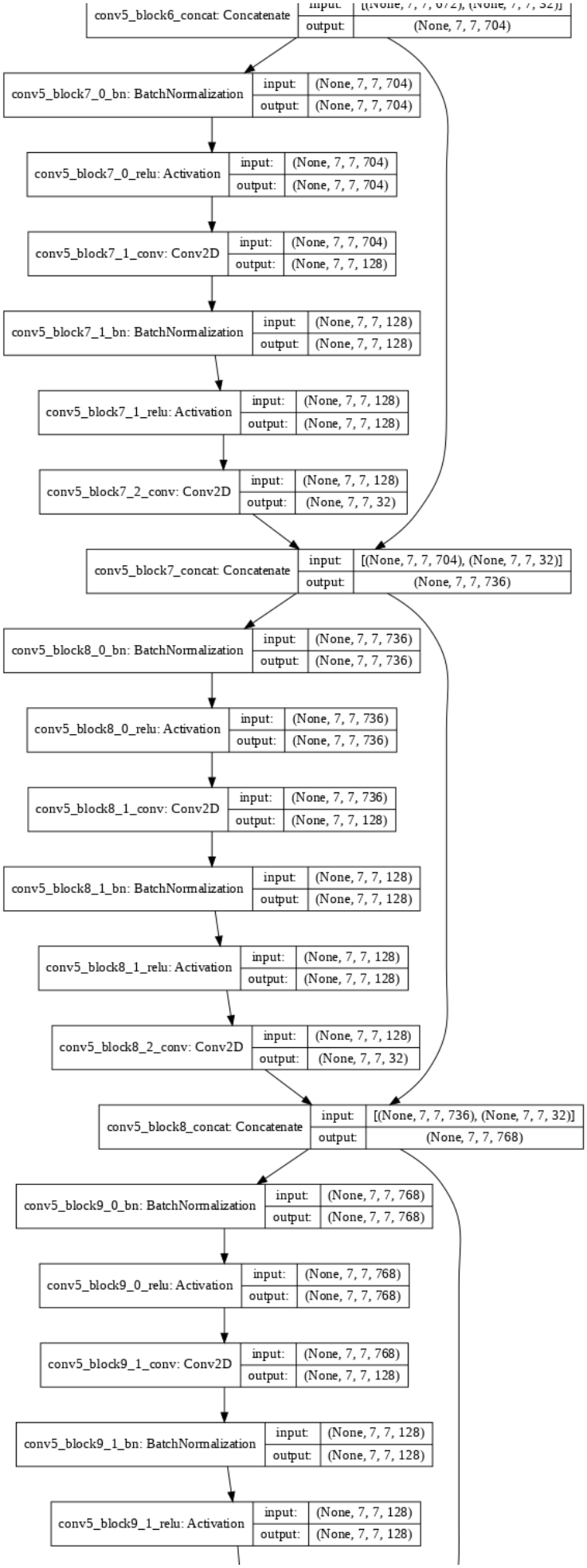
```
dense (Dense)                (None, 14)                14350     avg_pool[0][0]
==================================================================================
Total params: 7,051,854
Trainable params: 6,968,206
Non-trainable params: 83,648
__________________________________________________________________________________
```

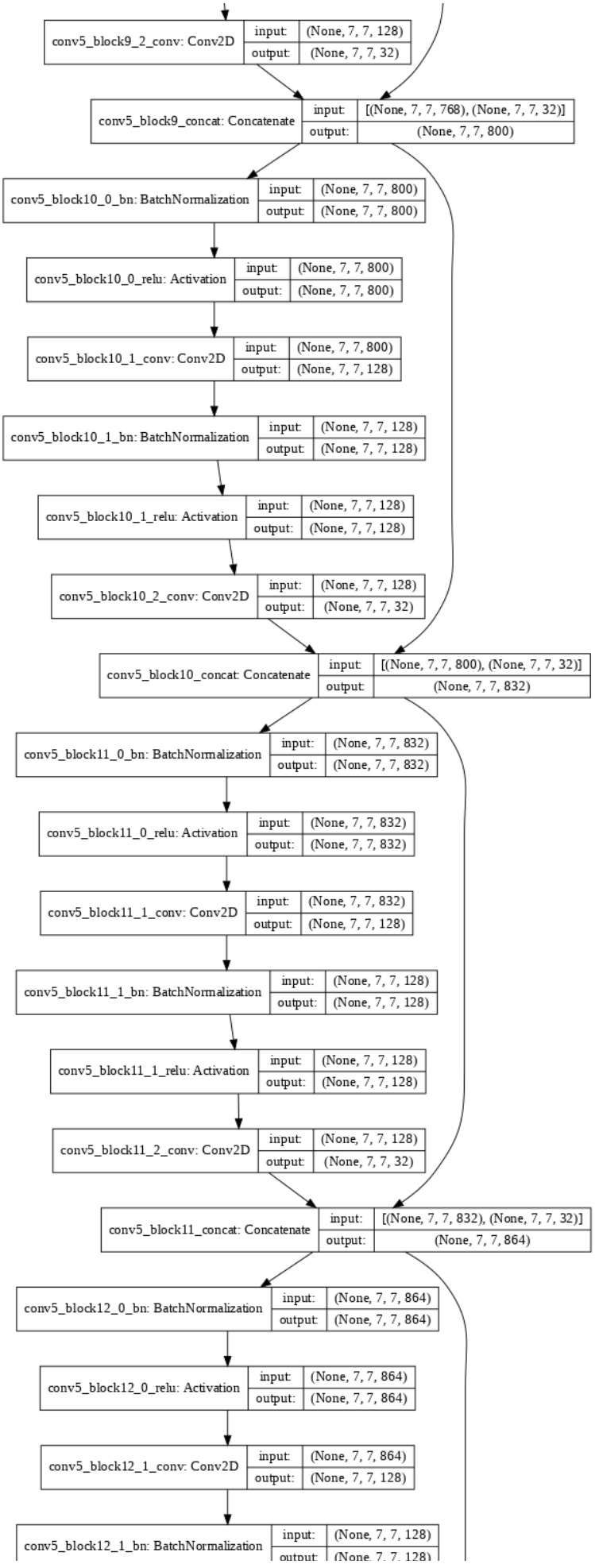
```
final_chexnet_model=Model(inputs=chexnet_model.inputs,outputs=chexnet_model.layers[-2].output
```

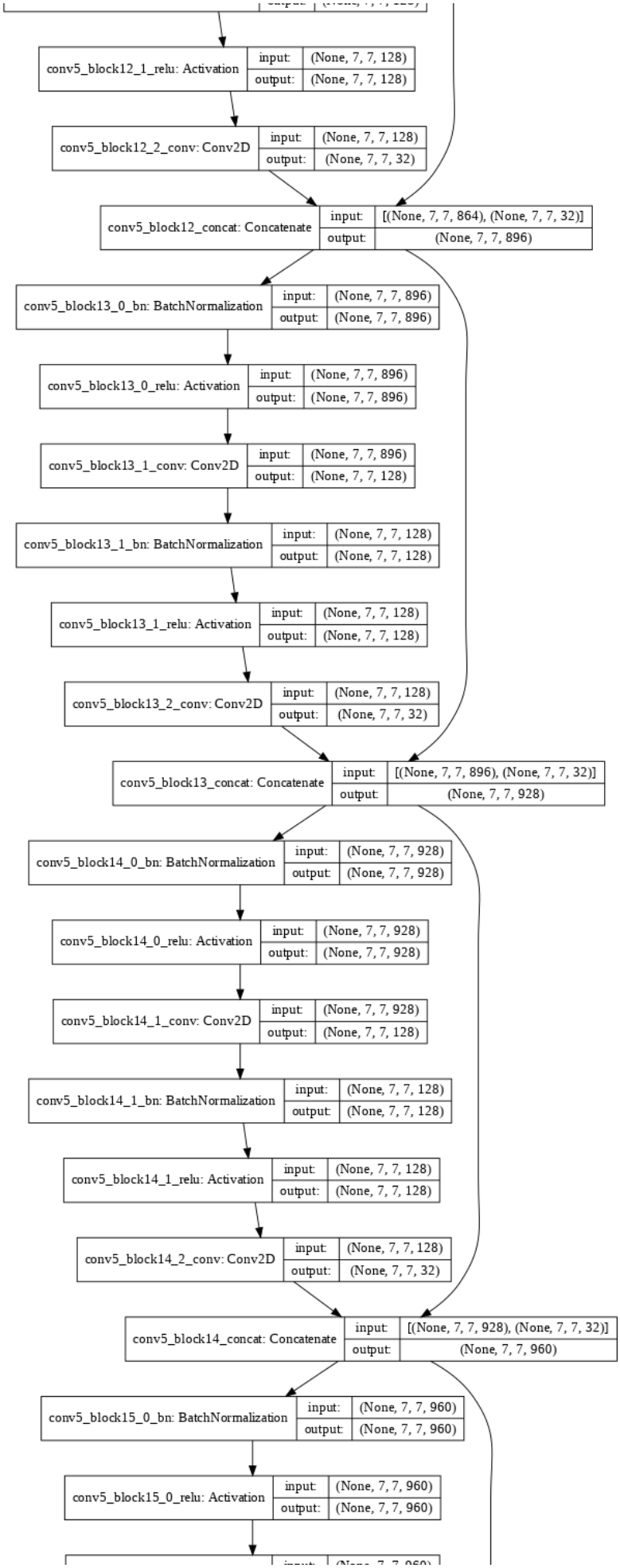
```
tf.keras.utils.plot_model(final_chexnet_model,show_shapes=True,show_layer_names=True,to_file=
```

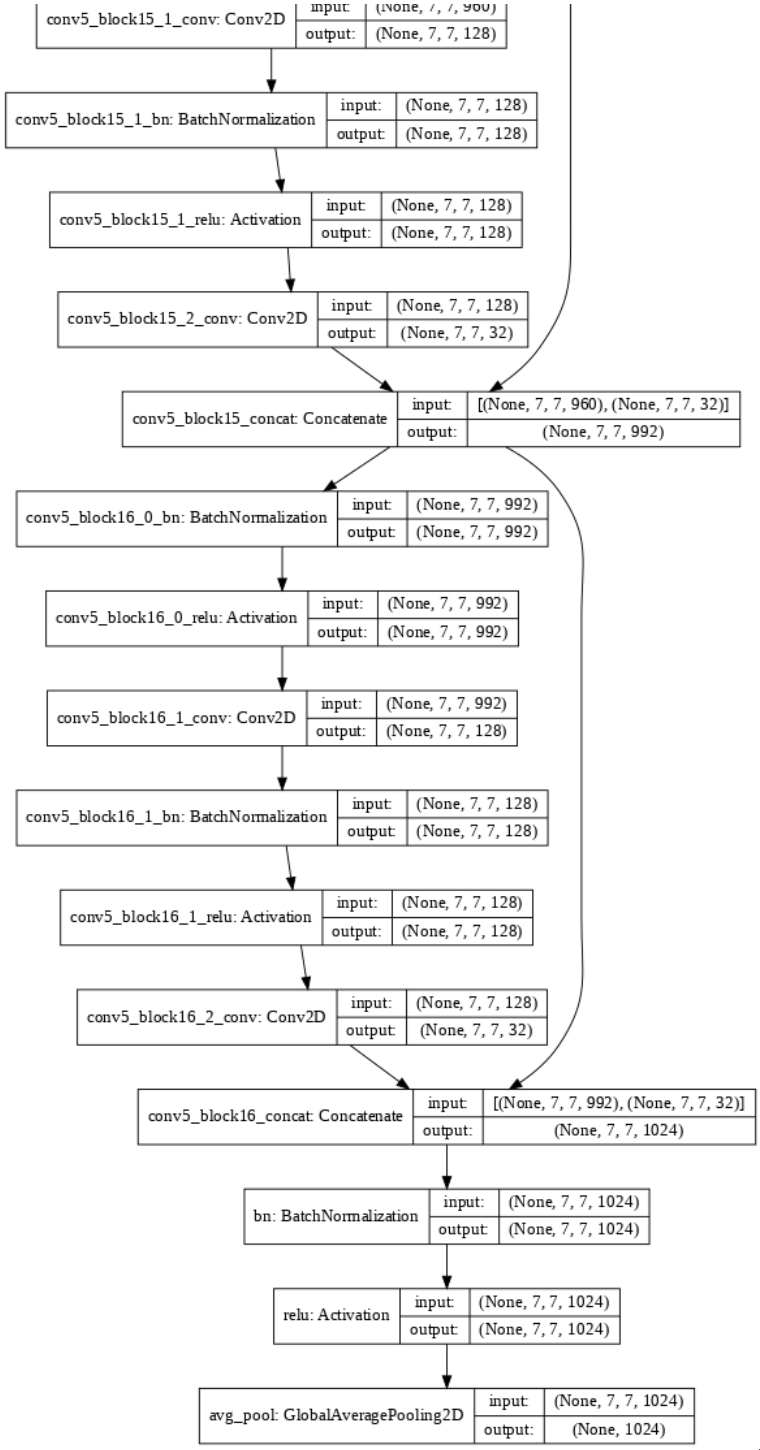

conv5_block1_1_conv: Conv2D | input: (None, 7, 7, 512) | output: (None, 7, 7, 128)
conv5_block1_1_bn: BatchNormalization | input: (None, 7, 7, 128) | output: (None, 7, 7, 128)
conv5_block1_1_relu: Activation | input: (None, 7, 7, 128) | output: (None, 7, 7, 128)
conv5_block1_2_conv: Conv2D | input: (None, 7, 7, 128) | output: (None, 7, 7, 32)
conv5_block1_concat: Concatenate | input: [(None, 7, 7, 512), (None, 7, 7, 32)] | output: (None, 7, 7, 544)
conv5_block2_0_bn: BatchNormalization | input: (None, 7, 7, 544) | output: (None, 7, 7, 544)
conv5_block2_0_relu: Activation | input: (None, 7, 7, 544) | output: (None, 7, 7, 544)
conv5_block2_1_conv: Conv2D | input: (None, 7, 7, 544) | output: (None, 7, 7, 128)
conv5_block2_1_bn: BatchNormalization | input: (None, 7, 7, 128) | output: (None, 7, 7, 128)
conv5_block2_1_relu: Activation | input: (None, 7, 7, 128) | output: (None, 7, 7, 128)
conv5_block2_2_conv: Conv2D | input: (None, 7, 7, 128) | output: (None, 7, 7, 32)
conv5_block2_concat: Concatenate | input: [(None, 7, 7, 544), (None, 7, 7, 32)] | output: (None, 7, 7, 576)
conv5_block3_0_bn: BatchNormalization | input: (None, 7, 7, 576) | output: (None, 7, 7, 576)
conv5_block3_0_relu: Activation | input: (None, 7, 7, 576) | output: (None, 7, 7, 576)
conv5_block3_1_conv: Conv2D | input: (None, 7, 7, 576) | output: (None, 7, 7, 128)
conv5_block3_1_bn: BatchNormalization | input: (None, 7, 7, 128) | output: (None, 7, 7, 128)
conv5_block3_1_relu: Activation | input: (None, 7, 7, 128) | output: (None, 7, 7, 128)
conv5_block3_2_conv: Conv2D | input: (None, 7, 7, 128) | output: (None, 7, 7, 32)
conv5_block3_concat: Concatenate | input: [(None, 7, 7, 576), (None, 7, 7, 32)] | output: (None, 7, 7, 608)
conv5_block4_0_bn: BatchNormalization | input: (None, 7, 7, 608) | output: (None, 7, 7, 608)


conv5_block4_0_relu: Activation
input: (None, 7, 7, 608)
output: (None, 7, 7, 608)
conv5_block4_1_conv: Conv2D
input: (None, 7, 7, 608)
output: (None, 7, 7, 128)
conv5_block4_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block4_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block4_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block4_concat: Concatenate
input: [(None, 7, 7, 608), (None, 7, 7, 32)]
output: (None, 7, 7, 640)
conv5_block5_0_bn: BatchNormalization
input: (None, 7, 7, 640)
output: (None, 7, 7, 640)
conv5_block5_0_relu: Activation
input: (None, 7, 7, 640)
output: (None, 7, 7, 640)
conv5_block5_1_conv: Conv2D
input: (None, 7, 7, 640)
output: (None, 7, 7, 128)
conv5_block5_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block5_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block5_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block5_concat: Concatenate
input: [(None, 7, 7, 640), (None, 7, 7, 32)]
output: (None, 7, 7, 672)
conv5_block6_0_bn: BatchNormalization
input: (None, 7, 7, 672)
output: (None, 7, 7, 672)
conv5_block6_0_relu: Activation
input: (None, 7, 7, 672)
output: (None, 7, 7, 672)
conv5_block6_1_conv: Conv2D
input: (None, 7, 7, 672)
output: (None, 7, 7, 128)
conv5_block6_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block6_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block6_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)


conv5_block6_concat: Concatenate
input: [(None, 7, 7, 672), (None, 7, 7, 32)]
output: (None, 7, 7, 704)
conv5_block7_0_bn: BatchNormalization
input: (None, 7, 7, 704)
output: (None, 7, 7, 704)
conv5_block7_0_relu: Activation
input: (None, 7, 7, 704)
output: (None, 7, 7, 704)
conv5_block7_1_conv: Conv2D
input: (None, 7, 7, 704)
output: (None, 7, 7, 128)
conv5_block7_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block7_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block7_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block7_concat: Concatenate
input: [(None, 7, 7, 704), (None, 7, 7, 32)]
output: (None, 7, 7, 736)
conv5_block8_0_bn: BatchNormalization
input: (None, 7, 7, 736)
output: (None, 7, 7, 736)
conv5_block8_0_relu: Activation
input: (None, 7, 7, 736)
output: (None, 7, 7, 736)
conv5_block8_1_conv: Conv2D
input: (None, 7, 7, 736)
output: (None, 7, 7, 128)
conv5_block8_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block8_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block8_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block8_concat: Concatenate
input: [(None, 7, 7, 736), (None, 7, 7, 32)]
output: (None, 7, 7, 768)
conv5_block9_0_bn: BatchNormalization
input: (None, 7, 7, 768)
output: (None, 7, 7, 768)
conv5_block9_0_relu: Activation
input: (None, 7, 7, 768)
output: (None, 7, 7, 768)
conv5_block9_1_conv: Conv2D
input: (None, 7, 7, 768)
output: (None, 7, 7, 128)
conv5_block9_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block9_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)


conv5_block9_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block9_concat: Concatenate
input: [(None, 7, 7, 768), (None, 7, 7, 32)]
output: (None, 7, 7, 800)
conv5_block10_0_bn: BatchNormalization
input: (None, 7, 7, 800)
output: (None, 7, 7, 800)
conv5_block10_0_relu: Activation
input: (None, 7, 7, 800)
output: (None, 7, 7, 800)
conv5_block10_1_conv: Conv2D
input: (None, 7, 7, 800)
output: (None, 7, 7, 128)
conv5_block10_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block10_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block10_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block10_concat: Concatenate
input: [(None, 7, 7, 800), (None, 7, 7, 32)]
output: (None, 7, 7, 832)
conv5_block11_0_bn: BatchNormalization
input: (None, 7, 7, 832)
output: (None, 7, 7, 832)
conv5_block11_0_relu: Activation
input: (None, 7, 7, 832)
output: (None, 7, 7, 832)
conv5_block11_1_conv: Conv2D
input: (None, 7, 7, 832)
output: (None, 7, 7, 128)
conv5_block11_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block11_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block11_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block11_concat: Concatenate
input: [(None, 7, 7, 832), (None, 7, 7, 32)]
output: (None, 7, 7, 864)
conv5_block12_0_bn: BatchNormalization
input: (None, 7, 7, 864)
output: (None, 7, 7, 864)
conv5_block12_0_relu: Activation
input: (None, 7, 7, 864)
output: (None, 7, 7, 864)
conv5_block12_1_conv: Conv2D
input: (None, 7, 7, 864)
output: (None, 7, 7, 128)
conv5_block12_1_bn: BatchNormalization
input: (None, 7, 7, 128)


conv5_block12_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block12_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block12_concat: Concatenate
input: [(None, 7, 7, 864), (None, 7, 7, 32)]
output: (None, 7, 7, 896)
conv5_block13_0_bn: BatchNormalization
input: (None, 7, 7, 896)
output: (None, 7, 7, 896)
conv5_block13_0_relu: Activation
input: (None, 7, 7, 896)
output: (None, 7, 7, 896)
conv5_block13_1_conv: Conv2D
input: (None, 7, 7, 896)
output: (None, 7, 7, 128)
conv5_block13_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block13_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block13_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block13_concat: Concatenate
input: [(None, 7, 7, 896), (None, 7, 7, 32)]
output: (None, 7, 7, 928)
conv5_block14_0_bn: BatchNormalization
input: (None, 7, 7, 928)
output: (None, 7, 7, 928)
conv5_block14_0_relu: Activation
input: (None, 7, 7, 928)
output: (None, 7, 7, 928)
conv5_block14_1_conv: Conv2D
input: (None, 7, 7, 928)
output: (None, 7, 7, 128)
conv5_block14_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block14_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block14_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block14_concat: Concatenate
input: [(None, 7, 7, 928), (None, 7, 7, 32)]
output: (None, 7, 7, 960)
conv5_block15_0_bn: BatchNormalization
input: (None, 7, 7, 960)
output: (None, 7, 7, 960)
conv5_block15_0_relu: Activation
input: (None, 7, 7, 960)
output: (None, 7, 7, 960)


conv5_block15_1_conv: Conv2D
input: (None, 7, 7, 960)
output: (None, 7, 7, 128)
conv5_block15_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block15_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block15_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block15_concat: Concatenate
input: [(None, 7, 7, 960), (None, 7, 7, 32)]
output: (None, 7, 7, 992)
conv5_block16_0_bn: BatchNormalization
input: (None, 7, 7, 992)
output: (None, 7, 7, 992)
conv5_block16_0_relu: Activation
input: (None, 7, 7, 992)
output: (None, 7, 7, 992)
conv5_block16_1_conv: Conv2D
input: (None, 7, 7, 992)
output: (None, 7, 7, 128)
conv5_block16_1_bn: BatchNormalization
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block16_1_relu: Activation
input: (None, 7, 7, 128)
output: (None, 7, 7, 128)
conv5_block16_2_conv: Conv2D
input: (None, 7, 7, 128)
output: (None, 7, 7, 32)
conv5_block16_concat: Concatenate
input: [(None, 7, 7, 992), (None, 7, 7, 32)]
output: (None, 7, 7, 1024)
bn: BatchNormalization
input: (None, 7, 7, 1024)
output: (None, 7, 7, 1024)
relu: Activation
input: (None, 7, 7, 1024)
output: (None, 7, 7, 1024)
avg_pool: GlobalAveragePooling2D
input: (None, 7, 7, 1024)
output: (None, 1024)